

I claim:

1. The compounds, modified lignin, lignin-cellulose resinous compounds, carbon dioxide, carbohydrates and ethanol produced from biomass by the process consisting of mixing, heating and reacting the components by the following steps:

(1). preparation of biomass:

excess water is removed from the biomass and ground or chipped into small pieces and utilized in the amount of 100 parts by weight;

(2). adding aqueous alkali metal hydroxide:

aqueous solution of alkali metal hydroxide containing 20 to 40 parts by weight of alkali metal hydroxide is added and mixed with biomass:

(3). converting biomass:

the biomass is heated to about 140 °C to evaporate water and break the lignin-cellulose bond then heating is continued while agitating until the biomass becomes a thick paste;

(4) dissolving converted biomass:

water in the amount of 200 to 400 parts by weight is added and mixed with the converted biomass thereby dissolving most of the converted biomass, then filtered or decanted off the non-water soluble biomass;

(5). adjusting the pH:

a acidic salt forming compound is added to the aqueous converted biomass solution until the pH is 3-7.

(6). separating the components:

the lignin-cellulose resinous products are skimmed from the top of the aqueous solution, the aqueous solution containing carbohydrates and salt is filtered or decanted off the precipitated modified lignin;

(7). crystalizing carbohydrates:

the aqueous carbohydrate and salt solution is heated to evaporate water to concentrate the solution then the carbohydrates are crystallized and precipitated out then the aqueous salt solution is filtered or decanted off;

(8). fermentation:

water is added to the carbohydrate crystals until a solution containing 15-40% carbohydrates, fermenting yeast is added, and the carbohydrate are fermented to produce ethanol and carbon dioxide;

(9). recovering ethanol:

ethanol is separated from the water by evaporation or by membrane technology;

(10). recausticing:

the aqueous solution containing salts of step 7 is heated to evaporate excess water then placed in a furnace, with or without lignin, burned to remove organic material, then added to water, filtered, then reacted with an alkaline earth metal oxide, to produce alkali metal hydroxide for reuse and alkaline earth metal carbonate which precipitates;

(11). alkaline earth metal oxide recovery:

the alkali earth metal is heated in a lime kiln to produce alkali earth metal oxide for reuse and carbon dioxide is collected.

2. The compounds of claim 1 wherein the alkali metal hydroxide is sodium hydroxide.
3. The compounds of claim 1 wherein the alkaline metal oxide is calcium oxide.
4. The compounds of claim 1 wherein the carbohydrates are crystallized out of the aqueous solution in step 4 of claim 1 then fermented by yeast into ethanol.
5. The compounds of claim 1 wherein the carbohydrates are separated from the modified lignin and salt after step 6, by means of membrane technology, then fermented by yeast into ethanol.
6. The process for the production of the compounds, modified lignin, lignin-cellulose resinous compounds, carbon dioxide, carbohydrates and ethanol produced from biomass by the process consisting of mixing, heating and reacting the components by the following steps:

(1). preparation of biomass:

excess water is removed from the biomass and ground or chipped into small pieces and utilized in the amount of 100 parts by weight;

(2). adding aqueous alkali metal hydroxide:

aqueous solution of alkali metal hydroxide containing 25 to 50 parts by weight of alkali

metal hydroxide is added and mixed with biomass:

(3). converting biomass:

the biomass is heated to about 140 ° C to evaporate water and break the lignin-cellulose bond then heating is continued while agitating until the biomass becomes a thick paste;

(4). dissolving converted biomass:

water in the amount of 200 to 400 parts by weight is added and mixed with the converted biomass thereby dissolving most of the converted biomass, then filtered or decanted off the non-water soluble biomass;

(5). adjusting the pH:

a acidic salt forming compound is added to the aqueous converted biomass solution until the pH is 3-7;

(6). separating the components:

the lignin-cellulose resinous products are skimmed from the top of the aqueous solution the aqueous solution containing carbohydrates and salt is filtered or decanted off the precipitated modified lignin;

(7). crystalizing carbohydrates:

the aqueous carbohydrate and salt solution is heated to evaporate water to concentrate the solution, then the carbohydrates are precipitated out, and the aqueous salt solution is filtered or decanted off;

(8). fermentation:

water is added to the carbohydrate crystals until a solution containing 15-40% carbohydrates , fermenting yeast is added, and the carbohydrate are fermented to produce ethanol and carbon dioxide;

(9). recovering ethanol:

ethanol is separated from the water by evaporation or by membrane technology;

(10). recausticing:

the aqueous solution containing salts is heated to evaporate excess water then placed in a furnace, with or without lignin, burned to remove organic material, then added to water,

filtered, then reacted with an alkaline earth metal oxide, to produce alkali metal hydroxide for reuse and alkaline earth metal salt which precipitates;

(11). alkaline earth metal oxide recovery:

the alkaline earth metal salt is heated in a lime kiln to produce alkaline earth metal oxide for reuse.

7 The product, carbohydrates, as produced by the process of claim 6.

8 The process of claim 6 wherein the alkali metal hydroxide is sodium hydroxide.

9. The process of claim 6 wherein the salt-forming compound is carbon dioxide.

10. The product, ethanol, as produced by the process of claim 6.

11. The product, modified lignin, as produced by the process of claim 6.

12. The product, lignin-cellulose resinous products, as produced by the process of claim 6.

13. The carbohydrates produced from biomass by the process consisting of mixing, heating and

reacting by the following steps:

(1) biomass is ground into small particles;

(2) aqueous sodium hydroxide is added to and mixed with the biomass;

(3) biomass is heated to remove excess water;

(4) biomass is heated to 140° to 200° C until the biomass swells and forms a thick fluid mass,

carbon dioxide is given off and collected, thereby producing a mixture of hemi-cellulose,

Carbonate,

(5) water is added and mixed to form a concentrated aqueous solution.

(6) carbon dioxide is added and mixed with the aqueous solution to react with the sodium

hydroxide to form sodium carbonate;

(7) carbohydrates form crystals and the aqueous solution is filtered off thereby recovering the

carbohydrates;

(8) the aqueous solution containing the modified sodium lignin, lignin-cellulose resinous

1-*st*-hemi-cellulose and sodium carbonate is evaporated, and the solid materials are

11.6 g more than water is added to recover the sodium carbonate;

(9) lime oxide is added and reacted with the sodium carbonate to form sodium hydroxide and calcium carbonate which precipitates, and aqueous sodium hydroxide is decanted off to be reused;

(10) calcium carbonate is heated in a lime kiln to recover calcium oxide for reuse and the carbon dioxide is collect for reuse.

14. The carbohydrates of claim 13 wherein water is added in an amount to produce a solution containing a 20 to 40 percent carbohydrates, then yeast is added to the solution to ferment the carbohydrates to form ethanol.
15. The product, ethanol, produced by the process of claim 14.